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(56) Documents Cited

GB 2306131 A	**GB 2223430 A**	**GB 2000457 A**
GB 1421238 A	**GB 1307714 A**	**GB 1278943 A**
GB 1277096 A	**GB 0858153 A**	**US 5152631 A**
US 4630980 A	**US 4379667 A**	

(58) Field of Search
UK CL (Edition Q) **B3B BHAD1 BHC1 BHC41 BHC5 BHC9**
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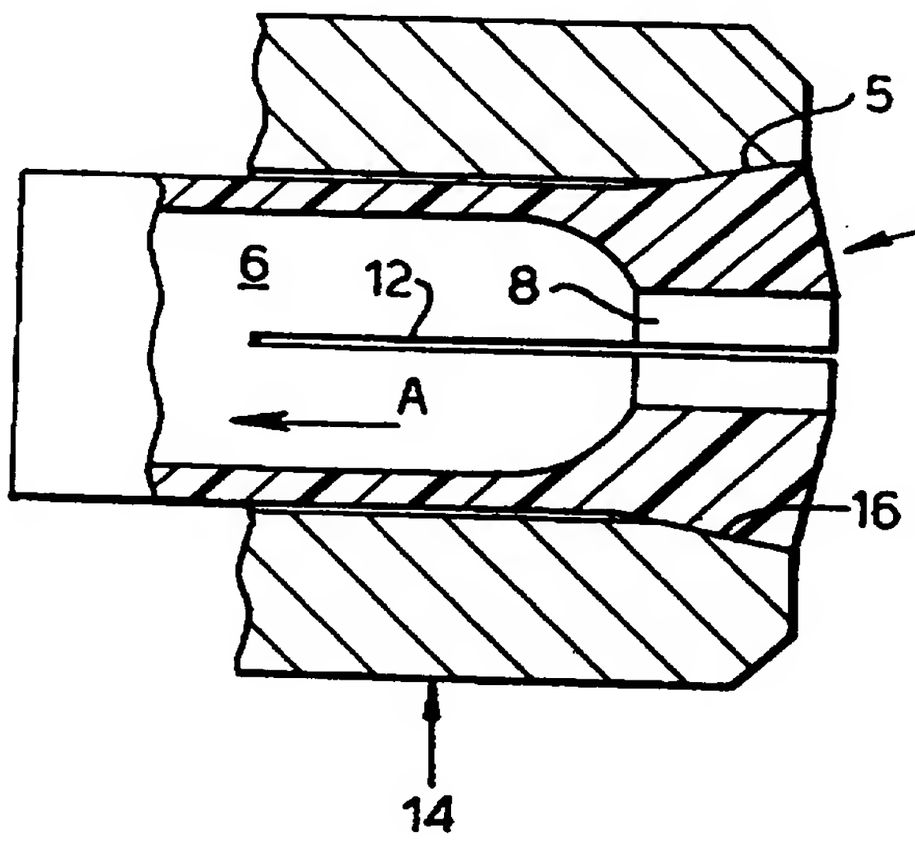
(54) Abstract Title
Collet

(57) A collet 4, for releasably holding a workpiece or tool, such as in machine tool apparatus, is made of non-metallic material such as thermoplastic material. The thermoplastic material is preferably reinforced with short fibres such as glass fibres or carbon fibres. Suitable thermoplastic materials include polyamide, polyacetal, polyamide imide, polyphenylene sulfide, ultra high molecular weight polyethene, liquid crystal polymers or polyarylamide. If the resilience of the material used to manufacture the collet 4 is suitable, then the collet can be manufactured without any slits 12, the collet thereby gripping the workpiece within the bore 6 using only the resilience of the material, which is preferably thermoplastic material.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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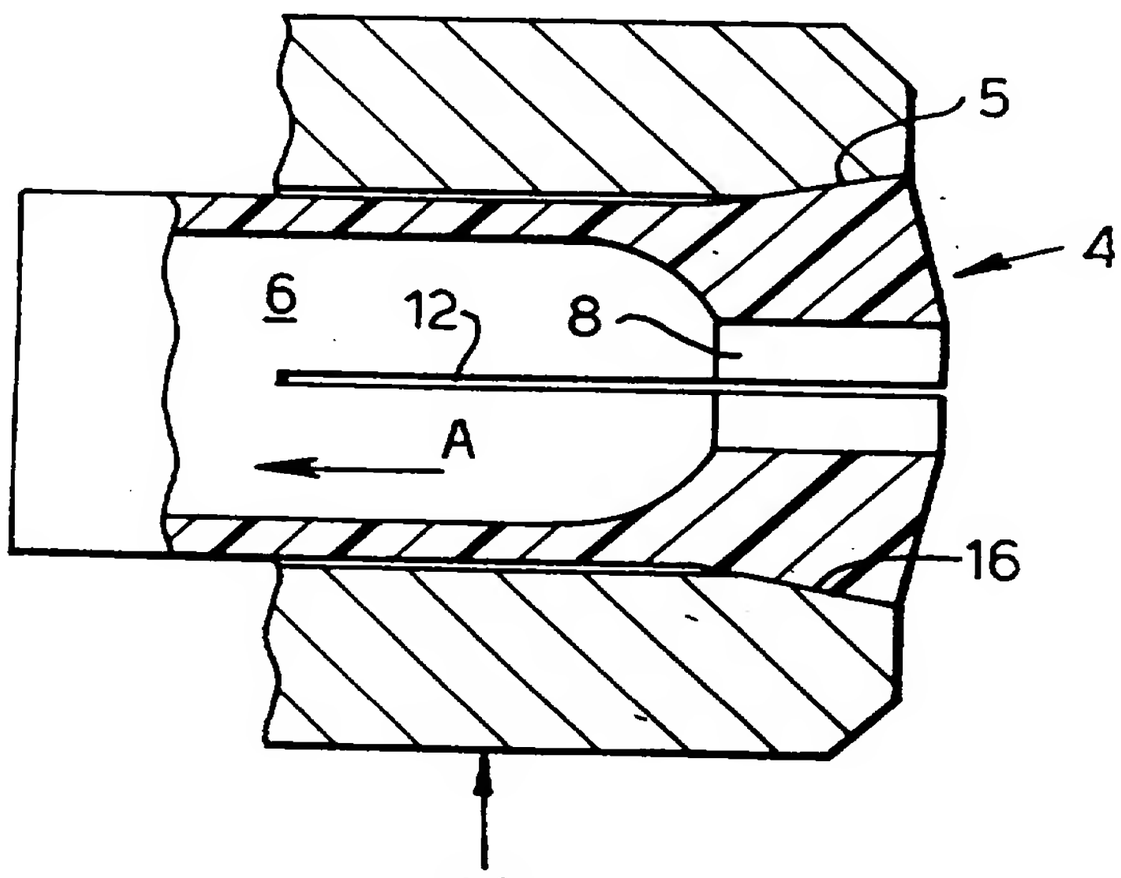
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COLLETS

The invention relates to collets, that is, devices for receiving and releasably holding a workpiece or a tool, to enable a machining operation to be carried out.

According to the invention, there is provided a slot-less collet.

According to the invention, there is also provided a collet, made from non-metallic material. The non-metallic material is preferably thermoplastic material.

According to the invention, there is further provided a collet made from thermoplastic material having a bore for receiving an object such as a workpiece or tool to be clamped in the collet, and releasable clamping means for applying an external constricting force to the collet to reduce the cross-section of the bore against the resilience of the material of the collet whereby to clamp the object.

Collets embodying the invention will now be described, by way of example only, with reference to the accompanying drawing which is a diagrammatic cross-section through a collet of known configuration.

The collet 4 shown in the Figure is of cylindrical shape with an outwardly tapered external surface 5. It has a hollow interior 6 which is open to a bore 8 for receiving a workpiece or tool. The wall of the collet is provided with slots extending through or partially through the wall and along the whole or part of its length, one such slot being shown at 12. A plurality of similar slots are provided at intervals around the collet. The slots 12 thus divide the tapered portion of the collet into segments spaced apart by the slots.

Collets of this known form are normally made from steel by a machining process.

In use, the collet is mounted within a sleeve part of which is shown generally at 14 and forming part of a machine tool. The sleeve has a tapered surface 16. A workpiece or tool to be clamped in the collet for machining purposes is inserted into the bore 8. Axial movement between the collet 4 and the sleeve 14 then takes place so that the collet 4 moves in the direction of the arrow A relative to the sleeve 14. The mating tapered surfaces 5 and 16 cause the segments of the collet 4 to tend to move towards each other against the resilience of the material of the collet, thus tending to close the slots 12 and firmly clamping the workpiece or tool within the bore 8.

The collet 4 shown in the Figure is shown merely by way of example: many different configurations may be used, depending on the application. However, the manufacture of such collets involves a series of turning, milling, heat treatment and grinding operations and the production of a large number of slots is labour-intensive, time consuming and expensive.

In accordance with a feature of the invention, it is proposed to manufacture collets in a suitably strong and resilient non-metallic material. Advantageously, a mouldable material is used. A preferred material is a thermoplastic material, preferably reinforced. The reinforcement may, for example, be by means of incorporated fibres or particulates, particularly short fibres such as glass fibres or carbon fibres. The use of such material achieves benefits in manufacturing time and cost, particularly where it enables the collets to be made by a moulding process such as injection-moulding.

Any suitable preferably reinforced thermoplastic material may be used. Examples of such materials include:

polyamides

polyacetals

polyamide imide

polyphenylene sulphide

ultra high molecular weight polyethylene

liquid crystal polymers

Polyamides (nylons) exhibit good mechanical properties, abrasion resistance, tend to be self-lubricating and are resistant to most chemicals. Nylons can be processed by all thermoplastic techniques including injection moulding.

Polyacetals have reasonable mechanical properties although stiffness and strength tends to be lower than for the nylons. However, the polyacetals do provide good abrasion resistance and can be processed by injection moulding.

Polyamide imides possess superior mechanical properties compared to the nylons. In particular they exhibit excellent fatigue resistance and good high temperature retention of mechanical properties. They also have outstanding fracture toughness and compressive strength. The Torlon grades contain 3-20% graphite powder, have low thermal expansion coefficients and are self-lubricating and are therefore particularly attractive for many tribological applications.

Polyphenylene sulphide (PPS) is a high temperature thermoplastic which exhibits superior mechanical properties compared to the more conventional thermoplastics. In addition to a high temperature capability, PPS has excellent chemical resistance and

is suitable for injection moulding.

Although the mechanical properties of ultra high molecular weight polyethylene (UHMWPE) are not as impressive as some other thermoplastics, UHMWPE does show outstanding abrasion resistance. Liquid crystal polymers (LCP) are a class of material that combine the properties of polymers with those of liquid crystals. Normally flexible polymers are converted into LCPs by incorporating rod-like or disc-like elements into their chains, which enhances mechanical properties such that the LCP behaves more like a fibre reinforced polymer. Conventional polymers have seldom been able to demonstrate the stiffness required to compete against traditional materials such as steel, but LCPs which contain long, straight chains can provide a significant improvement in mechanical performance.

The addition of reinforcement to thermoplastics in the form of short fibres or particulates is advantageous in order to enhance both stiffness and strength. However, the reinforcement may also influence other mechanical properties and wear resistance in differing ways. A suitable reinforcement is short glass fibres or carbon fibres. These generally provide significant improvements in stiffness and strength in a cost-effective way. An optimum reinforcing fraction of glass fibres of around 30wt% can be used.

The influence of fibre additions to the polymer on wear resistance depends primarily on the hardness and ductility of the matrix material. For thermoplastics that exhibit relatively high elongation to failure, for example nylon and polyacetal, the addition of a reinforcing phase always results in a reduction in wear and resistance. On the other hand, the less ductile thermoplastics such as PPS and LCPs may benefit substantially. For example, the addition of 30 wt% glass fibre to PPS reduces the specific wear rate against steel (pv = 3 MPa ms^{-1}, p = 0.3 MPa) by more than three orders of magnitude. This analysis suggests that the combination of stiffness and wear resistance that will be required for the collet application is best obtained by using a glass fibre reinforced polyamide imide, PPS or LCP. Another possible material is a glass fibre reinforced polyarylamide.

It is believed that materials selected from those suggested above may be used to produce collets of the same general configuration as are at present machined from steel. It may be necessary, however, to make various modifications to the design of the collet in order to take account of the process by which such collets are made. For example, if the collets are to be made by injection-moulding, the design of the collets needs to be such as to facilitate removal from the mould.

The collets to be made with the non-metallic materials described above may be made with slots corresponding to the slots 12. However, use of these materials may enable a change in the configuration of the collets. For example, collets made from thermoplastic materials are envisaged which are not provided with slots (corresponding to the slots 12); instead, the material is sufficiently resilient to enable it to be compressed onto the workpiece or tool and hold it sufficiently firmly. Such slitless collets may have manufacturing and operational advantages.

CLAIMS

1. A slot-less collet.

2. A collet according to claim 1, made from non-metallic material.

3. A collet according to claim 2, in which the material is thermoplastic.

4. A collet, made from non-metallic material.

5. A collet according to claim 4, in which the material is thermoplastic material.

6. A collet made from thermoplastic material having a bore for receiving an object such as a workpiece or tool to be clamped in the collet, and releasable clamping means for applying an external constricting force to the collet to reduce the cross-section of the bore against the resilience of the material of the collet whereby to clamp the object.

7. A collet according to claim 6, in which the bore is defined by a surrounding wall which is provided with one or more slits aligned with the axis of the bore whereby to increase the

resilience.

8. A collet according to any one of claims 3,5,6 and 7, in which the thermoplastic material is selected from polyamide; polyacetal; polyamide imide; polyphenylene sulphide; ultra high molecular weight polyethylene; liquid crystal polymers; and polyarylamide.

9. A collet according to any one of claims 3,5 and 6 to 8, in which the thermoplastic material is reinforced with short fibres.

10. A collet according to claim 9, in which the thermoplastic material is reinforced.

11. A collet according to claim 10, in which the short fibres are glass fibres.

12. A collet according to claim 10, in which the short fibres are carbon fibres.

13. A collet according to any preceding claim, made by a moulding process.

14. A collet according to claim 13, in which the moulding process is injection-moulding.

15. A collet made of non-metallic material and substantially as described herein.

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Application No: GB 9820967.9
Claims searched: 1-3,8-14

Examiner: Dr Steve Chadwell
Date of search: 8 December 1998

Patents Act 1977
Amended Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B3B (BHAD1, BHC1, BHC9, BHC41)

Int Cl (Ed.6): B23B 31/02 31/10 31/117

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2223430 A	(FRENCO...) see page 1 lines 4-17	1-3,9-14
X	GB 2000457 A	(MORITA...) see especially all figures; page 1 lines 58 to 72	1-3,13,14
X	GB 1421238	(MORITA...) see especially page 1 line 84 to page 2 line 43	1-3,13,14
X	GB 1307714	(HEALD...) see whole document	1-3, 10,13,14
X	GB 1278943	(KALTENBACH...) see figures 1 to 3; page 2 line 85 to page 3 line 2	1-3,8, 13,14
X	GB 1277096	(HYDRA-LOCK) see especially page 2 lines 28 to 73; page 3 lines 16 to 54	1-3,8-11,13,14
X	GB 858153	(HUMBERG) see page 1 line 68 to page 2 line 8	1-3,13,14
X	US 5152631	(BAUER) see column 3 lines 15 to 57; figures 1 to 3	1-3,13,14
X	US 4630980	(KUBO) see figure 2e in conjunction with figure 1	1-3,13,14

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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Application No: GB 9820967.9
Claims searched: 1-3,8-14

Examiner: Dr Steve Chadwell
Date of search: 8 December 1998

Category	Identity of document and relevant passage		Relevant to claims
X	US 4379667	(YOSHIMOTO et al) see especially figures 1 and 2; column 2 line 57 to column 3 line 19	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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Application No: GB 9820967.9
Claims searched: 4,5,8-15

Examiner: Dr Steve Chadwell
Date of search: 11 August 1999

Patents Act 1977
Further Search Report under Section 17

Databases searched:

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Int Cl (Ed.6): B23B 31/02 31/10 31/117 31/20

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2306131 A	(IMI...) see whole document, especially page 9 line 19 to page 12 line 3	4,5,8, 13,14
X	GB 2223430 A	(FRENCO...) see page 1 lines 4-17	4,5,9-12
X	GB 2000457 A	(MORITA...) see especially all figures; page 1 lines 58 to 72	4,5
X	GB 1421238	(MORITA...) see especially page 1 line 84 to page 2 line 43	4,5
X	GB 1307714	(HEALD...) see whole document	4,5,10
X	GB 1278943	(KALTENBACH...) see figures 1 to 3; page 2 line 85 to page 3 line 2	4,5,8
X	GB 1277096	(HYDRA-LOCK) see especially page 2 lines 28 to 73; page 3 lines 16 to 54	4,5,8-11
X	GB 858153	(HUMBERG) see page 1 line 68 to page 2 line 8	4,5
X	US 5152631	(BAUER) see column 3 lines 15 to 57; figures 1 to 3	4,5

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Claims searched: 4,5,8-15

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&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.